



Ultra-Efficient Engine Technology Program

Technical Accomplishment



Advanced Thermal Barrier Coating (TBC) Composite Selected for Increasing Temperature Capability of Turbine Airfoil System

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UEET Project: Materials and Structure for High Performance

Relevant Level 1 Milestone: Low conductivity Ceramic TBC Concepts Selected, September 2000

Shown: 1) Identification of chemistry window with greatest potential to meet low conductivity TBC goals
2) Preliminary physical vapor deposition (PVD) results

Accomplishment / Relation to Milestone and ETO:

- Evaluated 33 new chemistries using GRC Plasma Spray Facilities, newly established Powder Processing Facility, and Advanced Laser Rig to simulate engine conditions.
- Established a range of promising chemistries with significantly lower thermal conductivities than current state-of-the-art.
- Determined that PVD processing (current production process for coating blades) appears feasible.

Future Plans:

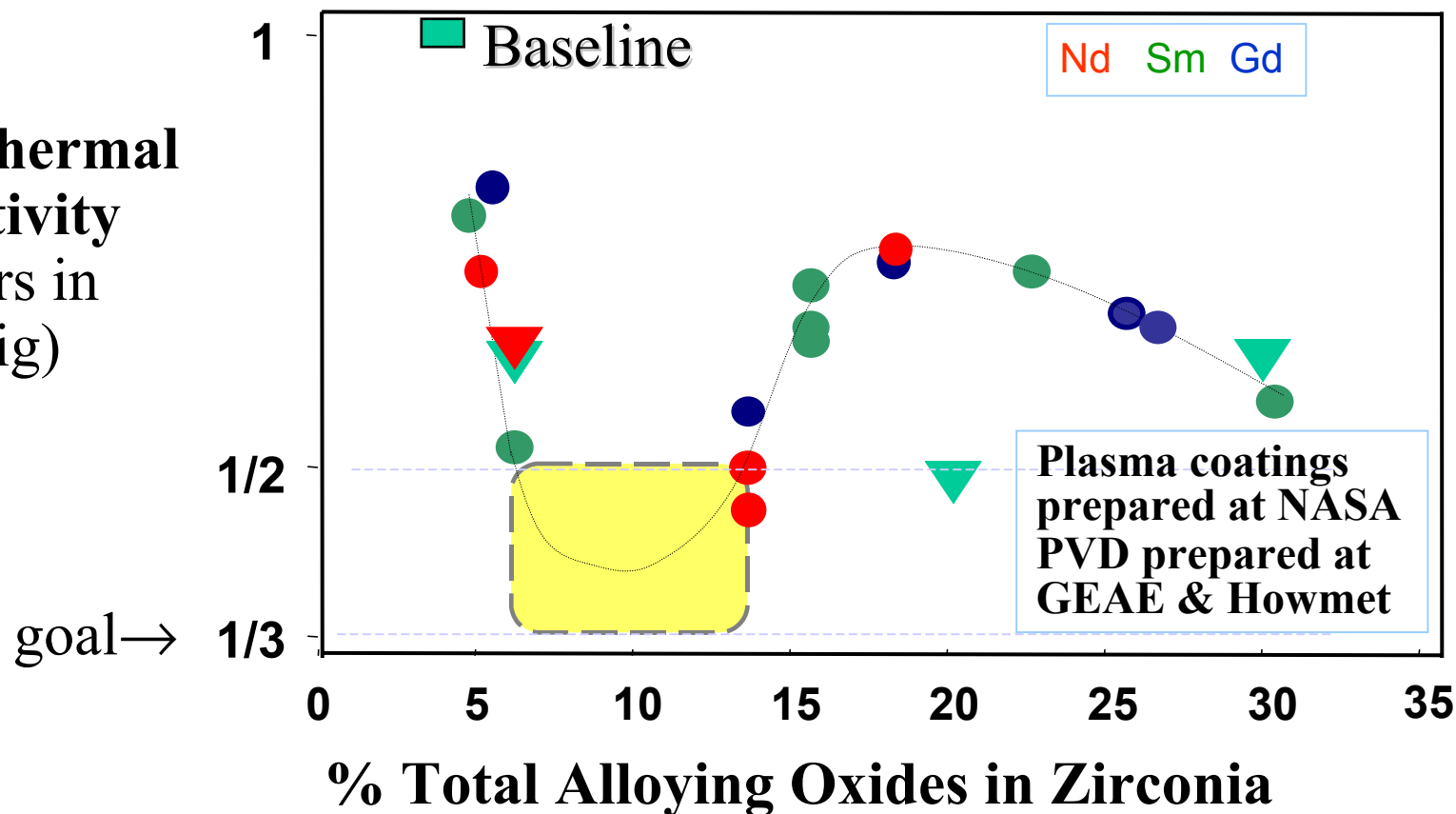
- Further refine the chemistry window of greatest potential.
- Evaluate alternate concepts, including structural modifications, to maintain low conductivity at long exposure times.
- Develop PVD process at multiple vendors and universities.



New Low Conductivity TBC Chemistry Window Identified

- 33 new plasma sprayed chemistries evaluated in 3 rounds
- Rare earth oxides Yb_2O_3 plus Nd_2O_3 , Sm_2O_3 or Gd_2O_3 added to $\text{ZrO}_2\text{-Y}_2\text{O}_3$

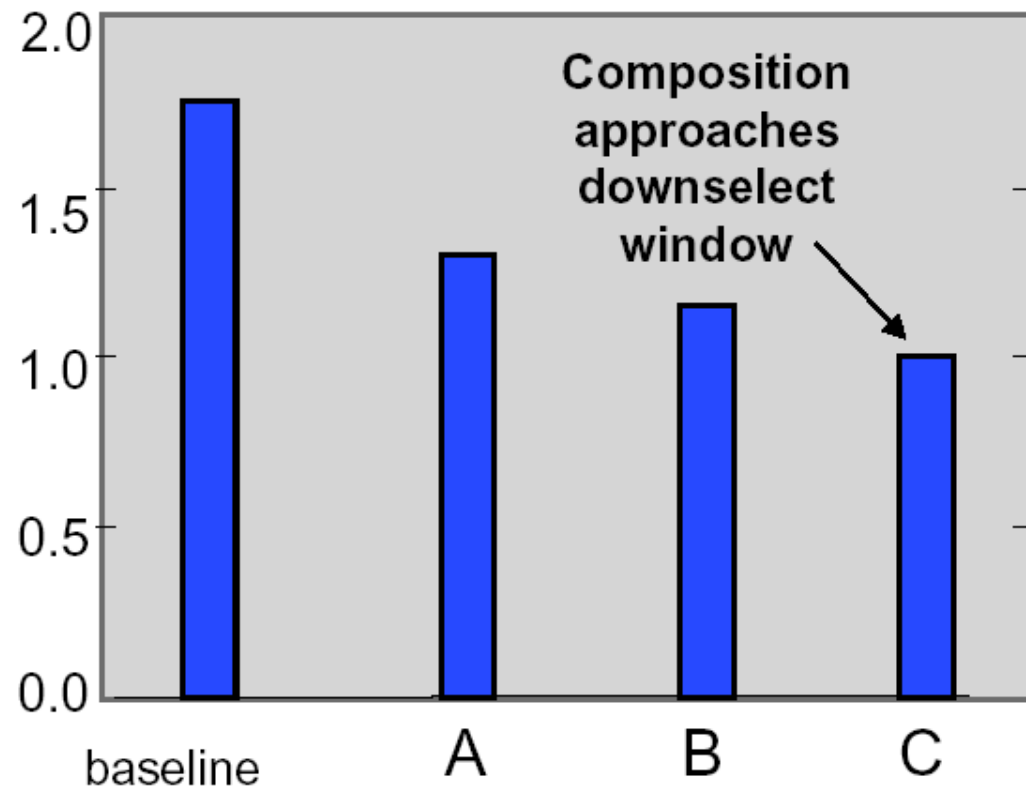
Relative Thermal Conductivity
(20 hours in laser rig)





Prel. Results for Physical Vapor Deposition (PVD) Process Are Encouraging

Thermal Conductivity
after 20 hours,
 k_{20} , W/m-K



PVD process development for selected compositions centered at GEAE, Howmet, and PSU